SPATIAL SCIENCE EDUCATION PRAXIS BENEFITS
EMPLOYEES AND EMPLOYERS

Associate professor F. R. Young,
Head, Surveying and Land Information
Faculty of Engineering and Surveying
University of Southern Queensland
TOOWOOMBA. QLD. 4350
Phone: +61 7 4631 2546
Fax: +61 7 4631 2526
youngf@usq.edu.au

KEYWORDS: Education, pedagogy, spatial science, flexible learning, CPD, GIS, surveying.

ABSTRACT

Professional education must enable students to determine learning opportunities to suit their personal and professional needs in preparedness for meeting work environment policy, technology and application challenges. The diverse needs for professional practice within the geospatial (surveying and mapping) profession have defined a requirement for new approaches and multiple varied work oriented learning opportunities.

In 2005, the University of Southern Queensland enhanced its unique suit of undergraduate, postgraduate and CPD study options, from which individuals can choose to enter the dynamically changing spatial science profession, emphasising the time, study mode and qualification levels flexibility. The opportunity to choose on-campus and off-campus delivery modes of study, or a combination of these, realises the dilemmas facing both emerging professionals and employer’s needs.

This paper will concentrate on examining the major criteria and benefits of the new user-defined technical and professional education Spatial Science programs developed at the University of Southern Queensland. It will also demonstrate the diverse range of the graduate’s professional skills, problem solving techniques, lateral thinking, teamwork and communication attributes required in meeting the challenges in spatial science employment.

INTRODUCTION

The Spatial Science profession is embracing changes imposed by dynamic employment and social environments and professional practice developments (Young, 1994 and Young, 2004). Similarly, education pedagogy and choice should evolve to empower students to determine learning opportunities to suit their personal and professional needs in preparedness for these new approaches and the opportunities in multiple and varied work environments. Employers should also be cognisant with graduate attributes to best manage the needs of the workplace.

The University of Southern Queensland has a unique suit of undergraduate and undergraduate study options, from which individuals can choose to enter the spatial science profession, that enable graduates to fit and develop with spatial science practices and trends. The opportunity to choose on-campus and off-campus distance delivery modes of study; different technical and professional
qualification levels; and the surveying and GIS majors, realises many of the dilemmas facing emerging spatial science and workplace changes. Moving freely between modes of study and qualification levels also benefits employers seeking to manage staff cadetships, scholarships, CPD or higher qualification studies. Particular teaching pedagogy developments also inculcate desired problem solving techniques, lateral thinking, application possibilities, teamwork and communication attributes that further motivate learning and interest in professional studies and developing a more useful graduate.

This paper will concentrate mostly on the undergraduate spatial science programs researched and developed by the University of Southern Queensland and accredited by the industry and the profession. It will also demonstrate how study can be user-defined and how the application of the graduate’s professional attributes melds to the varied challenges facing spatial sciences practice and employment requirements.

BACKGROUND

The formation of the Spatial Sciences professional body is embracing changes that reflect recent and continuing political pressures and regulatory changes, social environment pressures and professional practices. These changes include modern technology, increased teamwork environments; an increasingly diverse range of work situations and individual's workplaces; job mobility; accountability; a more intense legal environment; and Government registration and legislative needs. Pressures to accept a three year degree minimum and registration for mine and engineering surveyors in Queensland and NSW is one example of recent changes.

To address these pressures, education and workplace experiences need to be providing a stimulating and relevant learning environment to generate enthusiasm and good learning and encourage more students to enter the spatial science profession. As a starting point, the University of Southern Queensland (USQ) provides a variety of learning and educational strategies for prospective students with varying backgrounds, locations, work environment needs, forms of access and levels of prior learning. The program’s certification established specific graduate attributes that provide the competence demanded by employers and governments. Different qualification level upgrade options need to be available to address different workplace practices and changes. Different employment structures also dictate the requirement for a multifaceted education and training structure.

The USQ curricula accounts for a heterogeneous national and international student cohort where 75% of students study by distance education (McDougall et al. 2003) because work, family or personal reasons prevent them from attending campus during normal hours. The diversity of pre university education and experiences, plus ongoing different experiences, are also accounted for by USQ. For example, Australian Schools responding to their own pressures are offering a greater breadth of education at the expense of depth in specific areas: a problem also experienced in New Zealand (Hannah 2004). High school graduates generally have a broader integrated approach to knowledge and skills and their application, but lack a deeper learning and understanding abilities compared to students from alternative routes, e.g. those from work place, mature age, overseas experience, TAFE, etc. Each student will reach his or her best potential only with appropriate, but individual, employer and USQ support strategies.

The USQ's spatial science program's development and re-accreditation retained or enhanced existing valued attributes and institutional supporting facilities. Retaining the two, three and four
year qualification (refer table 1) was essential to address the need for different employment environments. The new option of a fourth professional year of study in geographic information systems (GIS) was introduced, together with the strengthened integration, articulation and other required changes, to meet the current and perceived needs of prospective students, society and spatial science employment.

Society and government require practitioners to have appropriate qualifications and authority to practice. They are also increasingly scrutinising professional activity and expect higher levels and breadth of technical abilities, reporting, analysis, evaluation, assessment, conceptualisation and synthesising. Our applications of practice processes must be contextualised and related to any impact on society and government thinking i.e. has social spatial connectivity. Hence, education should provide skills to enable graduates to be proactive, innovative and have lateral thinking or entrepreneurial skills. Although conclusive knowledge of future expertise is not possible (Young 1997; 2004; and Hannah 2004), new graduates entering professional praxis will need to have:

- Good communication skills;
- Current technical competence;
- A high level of conceptual and thinking skills;
- A capacity for innovative thinking, good judgements and analytical and critical evaluation;
- An ability to adopt and adapt;
- A spatial science’s technology literacy and numeracy;
- A spatial connectivity ability;
- A capacity for contextual understanding of their work environments;
- An ability to discriminate between and use information sources;
- Administrative, management and human relations abilities;
- A capacity to synthesis knowledge for solving problems and decision making;
- Knowledge of individual responsibilities and accountability;
- Skills to manage within time and resource constraints;
- An ability for future independent and lifetime learning; and
- A suitably developed attitude, motivation and behaviour focus in accordance with the profession.

SPATIAL SCIENCE CURRICULUM OPTIONS

The Surveying and Land Information Discipline offers its own unique spatial science degree programs but shares some individual courses (subjects) with pertinent engineering programs. These programs form a new articulated suite of different undergraduate degree levels (table 1 and figure 1) of offerings that enable students to progress to their highest academic potential in the major of their choosing: employers provide further in-depth training and experience.

<table>
<thead>
<tr>
<th>COMMON COURSES</th>
<th>ELECTIVES</th>
<th>RESIDENTIAL SCHOOLS</th>
<th>STUDY TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total courses</td>
<td>Common/ Core + major courses</td>
<td>SVY</td>
</tr>
<tr>
<td>ADSS</td>
<td>16</td>
<td>9 + 7</td>
<td>1</td>
</tr>
<tr>
<td>BSST</td>
<td>24</td>
<td>13 + 11</td>
<td>2</td>
</tr>
<tr>
<td>BSPS</td>
<td>32</td>
<td>19 + 13</td>
<td>3</td>
</tr>
</tbody>
</table>

**CODES:**
- ADSS - Associate Degree in Spatial Science
- BSST - Bachelor of Spatial Science Technology
- BSPS - Bachelor of Spatial Science
- SVY - Surveying
- GIS - Geographic Information Systems
- F/T - minimum full-time study duration
- P/T - minimum part-time study duration

Table 1. Course commonality of undergraduate programs.
The spatial science programs accommodate the diverse entry avenues, including applicants from Year 12 (or equivalent), another discipline, change of major specialisation, a mature age situation and other institutions. Students can enter any of the undergraduate programs of their choice, restricted only by their present level of achievement or credits on previous studies. USQ also offers Tertiary Preparation Programs that enable individuals, without the minimum year 12 matriculation, inadequate language or mathematical abilities, or in need of "refreshing", to achieve a suitable tertiary entrance standard. This program can be completed on-campus or off-campus without leaving a current work place or home. These options also enable employers to manage employee opportunities, including cadetships, scholarships or time release, while still accommodating workplace needs. The optional graduate exit and entry points (figure 1) and the interrelationship (figure 2) of the programs outline the opportunities for new study programs and post graduates seeking further qualifications or continuing professional development (CPD). Individual courses can be studied without enrolling in a program (for updating knowledge or as a CPD activity).

Figure 1. Entry and exit options for Spatial Science program’s.

For both the surveying and GIS majors (figure 2), there is the four (4) year Bachelor of Spatial Science degree, the three (3) year Bachelor of Spatial Science Technology degree and the two (2) year Associate Degree in Spatial Science. The study paths of each major are hierarchical with a high course commonality between these majors and a seamless vertical articulation within majors. The various exit and re-entry options, together with the free movement between the surveying and GIS majors, provide students and employers with multiple options to satisfy their needs and the development within employment.
The hierarchical structure and seamless articulation of the programs address the following cognitive stages and different practice levels within the spatial science practice:

- First-year courses assimilate students into the profession and its role. It also establishes basic technical competence; technical knowledge; and personal organising; communication and problem solving abilities.
- Second-year courses provide a higher technical competence and applications knowledge and the ability for to lead a small field party or complete more complex technical tasks under supervision.
- Most of the highest technical competence and understanding is achieved with the completion of the third-year courses. Graduates can independently conduct, report on and lead and manage technical tasks.
- The fourth-year courses are largely professional and project management skills oriented, but include higher ‘academic’ research studies. This year prepares graduates to meet professionalism and management demands, the intellectual challenges of continuing professional development, and addresses higher level technical and innovative application needs.

**Student Empowered Study Options**

Students are able to select any of the six degree options that best suits their financial, workplace, technical or professional and personal needs (McDougall et al. 2003; Young 2002). If they enter at a ‘lower’ level degree they are able to progress, or later return, to a higher degree program with full credit of their previously completed studies (refer figure 1). Similarly, if a bachelor program is
unable to be completed, a student may revert to a lower level program and, with sufficient course credits, graduate with a recognised qualification.

Figure 3 displays each of the degrees and the two major (surveying and GIS) study options for the Bachelor of Spatial Science degree, Bachelor of Spatial Science Technology and Associate Degree in Spatial Science: Figure 4 combines these degrees to demonstrate the commonalities. The colour coding in the Common/Core section depicts the courses common to the different degree levels and both the majors. Certain courses are studied in each degree: the difference between degrees is the inclusion of courses not studied at the lower levels. There is also course commonality across degree levels within both of the majors in the Majors section. Within the majors specialisation courses a number of electives allow individuals to further choose preferred or workplace needed specialisation.

Student Support: Benefits For Students And Employers

User defined education works best when the user can choose from a range of appropriate and substantial student support. Administrative, distance education and academic staff are all contactable through a variety of mechanisms including: email; telephone; facsimile; post; Outreach (a specialised student support service); regional centres; the on-campus international Office; offshore agency offices; and through the USQConnect student web portal. Students select which of these services they require to assist in pedagogical aspects pertinent to individual needs.
The majority of the courses have customised study materials developed by the staff. These may include an introductory book (assessments, administration and study information); study book; book of readings; and multimedia enhancement materials (hardcopy, CD/DVD or web based). The first two chapters of each study book are accessible via the web to enable student to commence before
the study material package arrives through the post. This allows off-campus students to better manage their own time and provides a near equivalent teaching and learning experience and information access to that of the on-campus student. The communications and material support assists students to better balance their work and study commitments.

For off-campus students, employer support enhances the student chances of success, earliest completion, personal/work place satisfaction and increased value to the employer. Support can be time off for exams; time for attendance at residential schools; mentoring; access to equipment and facilities; and project work assistance, through to scholarships, cadetships (full-time or part-time) and other mutually beneficial arrangements.

Fully external off-campus students will normally complete their program in more that the minimum time: for some it is up to 50% more time than the minimum because of the personal and workplace pressures. This is discouraging for students and delays the acquisition of abilities that maybe useful at an earlier time in their employment.

Student scholarships, off work-time allowances and workplace facilities support to assist in the studying commitments are individual to the workplace. Alternative arrangements to reduce the study time burden and an earlier graduation, and hence reach full employment value earlier, can be achieved with USQ's flexible education structure. Two simple employer support solutions are:

- Sponsor (tied or untied cadetship or scholarship) a student to study full-time. With approximately 30 weeks on-campus per year, the student is available for 15 to 22 weeks per year at the workplace and returns each time with a familiarity of that work environment.
- Support a student for 1st year on-campus to enable workplace useful basic skills to be learnt and follow up with six months or one-year periods of off-campus and on-campus studies. This will assist in reducing the time to reach graduation, help enthuse the student and to bring increasingly useful skills more quickly to the workplace. Overlapping 2 to 3 concurrently sponsored cadetship will provide a continuous staffing arrangement.

**PROBLEM BASED LEARNING: EMPLOYMENT RELEVANCE**

**Problem Based Learning Concept**

The concept of problem based learning aims to use the unique student experiences diversity and abilities in a collaborative and co-operative based learning environment to the advantage of all participants. Specific problem based learning (PBL) pedagogy in all courses is playing an increasing role to realistically prepare graduates for the challenges faced in a team workplace praxis. Team based problem activities learning advances verbal and written communication skills; comprehension of group dynamics; personal and interpersonal skills and problem solving abilities; and creates an understanding of possible alternative solutions.

Problem based learning achievements can be likened to the more commonly discussed competency attributes of professionals. A competency is defined as a combination of attributes, such as knowledge, abilities, skills and aptitudes, underlying specified aspects of successful professional performance (Higher Education Division 1992). While problem solving is listed as a professional competency statement, the problem solving courses encompass the expected outcomes of: collection, analysing and organising information; communication; planning and organising; team work; mathematics application; problem solving and using technology (NTB 1992). Competency
standards are applicable to all levels of training and education, from mundane tactile tasks to the highest level of professional attitudes. Hence, problem based learning principles are of significant importance in contemporary spatial science education. It is also hoped that problem based learning may enable student's to understand their chosen career path; generate more interesting and exciting learning; and address the decline in university enrolments, and hence graduate numbers.

**Problem Based Learning Outcomes**

Two specific PBL courses are core Faculty of Engineering and Surveying course and include surveying, GIS, civil, agricultural, environmental, electrical and electronic, mechanical, mechatronic and computer systems students. Other problem learning is done in the practice courses, the Research Project and is contextualised within most courses. The PBL courses involve students globally in a multicultural environment; in interdisciplinary teams; multi-skilled teams; sharing activities on an around the clock basis; utilising digital communication tools; and working in a virtual environment.

The skills acquired in the Problem Solving 1 and 2 courses are built on throughout the program, as integral elements of each course, to achieve professional and technical competence. The final year problem solving activity is the independent Research Project dissertation of approximately 25,000 words: there is an associated professional conference environment presentation. This dissertation is expected to demonstrate all the skills and knowledge gained from the student’s program: it also establishes competence in researching, major report writing and professional verbal communications. Problem based learning methodology and techniques empower students to cope with the technical and non-technical demands of the curricula, and to more seamlessly and confidently enter the workforce.

In summary, multidiscipline problems solving in teams focuses on the following skills experienced and learnt in context:

- Planning, organising, and managing (group and personal).
- Written, verbal and visual communication.
- Mathematics, physics and statistics knowledge, application and relevance.
- Teamwork and individual contribution.
- Basic research techniques.
- Knowledge-based association with other disciplines and role or function of his/her own discipline in relation to other professions and society.

The four tasks (small projects) in this course are designed to compel student to learn and apply, within a spatial science and engineering context, fundamental computing, physics and statistics. They also develop criteria for the team’s role; generic codes of conduct and co-operations processes for organizing a team; and conflict resolution procedures. Other learning outcomes include the reinforcement of study skills; research methodology; lateral thinking and application techniques; personal and interpersonal commitment; and management and responsibilities of professional practice.

These courses provide a broad spectrum and skills and knowledge plus the ability for self learning. These abilities empower individual learning, interpretation, comprehension techniques, personal and inter-personnel development and the ability to evaluate and extract the best from the professional course's content and integrate into a work-place environment.
CONCLUSIONS

The USQ spatial science programs content was researched, strategically planned and systematically integrated to enable an evolution for changes in current and perceived future technical and workplace trends. With the addition of the institutional student support infrastructure, these are sustainable and quality accredited programs in both off-campus distance education and on-campus modes. Academic education standards have been maintained while incorporating market-place forces developments where possible. Increased targeted employer support for students was acknowledged as being able to enhance graduate attributes for the benefit of both the graduate and the employer.

Flexibility through study modes, program content, contextual problem solving learning, and interrelated undergraduate program options address paraprofessional and professional education needs in a cohesive, integrated and co-operative approach. This structure also addresses the social issues, workplace restrictions and the general limited time and economic resources concerns of each individual participant. The programs provide user-defined or user-determined education that specifically empowers students to determine learning opportunities and graduate attributes to suit both their personal and professional praxis needs. User defined quality professional education is regarded as highly desirable, has been shown to be achievable, and provides opportunity and benefits for both the employee and the employer.

REFERENCES


NTB (1992), Industry Competency Standards and Key Competencies, The National Training Board Ltd., Australia, AGPS.


